The Meteorological Magazine

Vol. 55

Oct. 1920

No. 657

Air Ministry :: Meteorological Office

LONDON : PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.

To be purchased through any Bookseller or directly from
H.M. STATIONERY OFFICE at the following addresses:
Imperial House, Kingsway, London, W.C. 2, and 28, Abingdon Street, London, S.W.; 37 Peter Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 23, Forth Street, Edinburgh; E. PONSONBY, Ltd., 116, Grafton Street, Dublin; or from The Meteorological Office, South Kensington, London, S.W. 7.

Back Radiation from the Sky.

By W. H. Dines, F.R.S.

APPARATUS has been fitted up at Benson by means of which the radiation from the sky can be read off at sight in gramme-calories per day or any other convenient unit on the scale of a mirror galvanometer. It consists of a thermo-electric pile of 120 pairs of copper-eureka junctions. The separate elements are of the shape and size of a two dimensional tadpole, if such an expression may be allowed, and are cut from sheet copper ·003 inch thick and from sheet eureka ·006 inch thick. The tail of each tadpole is soldered to the body of the next so as to form a long string of alternate circles and narrow strips, the different metals occurring, of course, alternately. A twist through a right angle is then given to each strip or tail so that the copper to eureka junctions all remain in one plane while the eureka to copper junctions are parallel to another plane at right angles to the first. A small cone of radiation falling upon such an arrangement heats the one set of junctions because it falls on them perpendicularly, but is almost without effect upon the other set because it catches them edgewise. The whole strip of junctions is rendered a dull black and there are no polished surfaces to deteriorate with time.

The junctions of the thermopile are distributed as symmetrically as possible over a 4 inch circle and are placed

(64)12514 Wt 105—P 35 1250 10/20 E & S A 2

4 inches from the inner end of a metal cylinder 2 feet long which is buried in a 40-gallon tank of water. The axis is horizontal and the cylinder has a 4-inch circular opening at the end through which the radiation enters; thus the cone of radiation dealt with has a semi-vertical angle of $\tan^{-1}\frac{2}{10}$. Just outside the opening a polished metal spherical mirror (of 4 feet radius) is placed which can revolve about the axis of the cylinder. The axis of the mirror is inclined to the axis of the cylinder at an angle of 45°, and by its use the cone of radiation can be directed to any part of the sky lying in one fixed vertical circle and, further, the semi-vertical angle of the cone is reduced to nearly one-half of its former value.

The instrument is calibrated thus. An equally spaced scale about 15 inches long, showing from 0 to 1,200 gramme calories per square centimetre per day, is prepared on tracing paper. Parallel to this and at a distance above it equal to the diameter of the bright spot a second scale is made indicating absolute temperatures. The numbers on this scale are such that they indicate the temperature at which one square centimetre of a full radiator will give out per day the number of gramme-calories indicated on the lower scale. Thus at 245a the radiation is 400 g.c. per day, and hence the 400 division of the g.c. scale lies below and in line with the 245 of the temperature scale. The scale so prepared is mounted on a stand so that it can slide longitudinally and any temperature be brought into coincidence with the light spot. Now the galvanometer scale can be altered by a shunt of variable resistance or by altering the distance of the scale from the mirror, and by one or both of these means the scale is so adjusted that a change in the radiation of 100 g.c. per day falling on the pile may shift the light spot over 100 divisions of the lower scale. The requisite change of 100 g.c. is obtained by taking first radiation from a black body at a temperature T and then raising the temperature to the requisite point to produce another 100 g.c. Thus, assuming the zero line to be in the right position, the light spot should show on the upper scale the precise temperature of the black body which is giving the radiant energy to the thermopile, and there is no difficulty in obtaining this condition over a range of 50° C. with an accuracy of at least ·5 of a degree.

The zero is adjusted thus. A cylinder, a glazed 9-inch drain pipe in fact, is partially buried in the ground vertically below the mirror and is half filled with water. Water is almost a full radiator and with the drain pipe forms an efficient black body, especially as its temperature is very little different from that of all neighbouring objects. The cone of radiation is directed downwards to the water in the drain pipe

and the prepared scale is then shifted longitudinally so that the light-spot may coincide with the temperature of the water in the drain pipe. The zero will change with change of temperature of the junction of the pile because it is the difference between the pile and the external source of radiation which actuates the galvanometer, but the temperature of the pile depends so largely upon that of the enclosure in which it is placed, which in turn depends on the surrounding water, that any change of zero is quite slow and gives no difficulty.

The instrument so adjusted is then turned to any part of the sky and gives on the upper scale the equivalent radiation temperature of that part of the sky, or on the lower scale the gramme-calories per day that would be given by a hemisphere of such sky to one square centimetre of surface.

The diffuse solar radiation prevalent while the sun is above the horizon can also be determined thus. Directing the cone of radiation towards a pane of window-glass with a sheet of bright metal at the back, the scale reading gives the radiation from the glass. Removing the metal backing, the scale reading rises because diffuse solar radiation can pass through the glass almost unimpeded. The difference in the readings is the diffuse solar radiation, and by subtracting this from the observed sky radiation the true sky radiation during the daylight hours can be obtained.

OFFICIAL NOTICES.

Discussions at the Meteorological Office.

At the request of the Director of the Meteorological Office, Sir Napier Shaw, Professor of Meteorology in the Imperial College of Science and Technology, and Reader in Meteorology in the University of London, proposes to continue the series of meetings commenced in 1905 for the informal discussion of important contributions to meteorological literature, particularly those by Colonial or Foreign Meteorologists.

The meetings will be held at the Meteorological Office, South Kensington, at 5 p.m. on Mondays, November 1st, 15th, 29th, December 13th, 1920; January 10th, 24th, February 7th, 21st, March 7th, 21st, 1921. On November 1st Sir Napier Shaw will open the discussion of two important papers by Prof. V. Bjerknes, viz.:—

(1) The Meteorology of the Temperate Zone and the General Atmospheric Circulation;

(2) The Structure of the Atmosphere when rain is falling.

London University Lectures.

As Reader in Meteorology in the University of London, Sir Napier Shaw, Sc.D., LL.D., F.R.S., will deliver at the Meteorological Office, South Kensington, a course of lectures entitled "A Historical Review of Meteorological Theory." The lectures, which will be on Fridays at 3 p.m., and will be followed by a practical class, commence on Friday, January 21st.

Admission to the lectures is free by ticket, to be obtained on application to the Reader at the Meteorological Office, South Kensington.

Summer Time Act.

In view of the threatened coal strike the Government announced that the period of Summer Time was to be extended. Accordingly, the public clocks did not resume Greenwich Time on September 27th, as had been anticipated in the notice in the last number of this Magazine.

The reversion is to be effected as from 3 h. (Summer Time) on Monday, October 25th. Observers are requested to state explicitly the standard of time on their returns for October and November 1920.

New Meteorological Station.

On August 19th, 1920, a reporting station was established at Flamborough Head Coastguard Station. This station is to report six times daily to the Meteorological Office at Howden by telegraph.

Official Publications.

Professional Notes No. 12. *An Analysis of the Rate of Ascent of Pilot Balloons at Butler's Cross, Salisbury Plain.* By R. P. Batty, B.A. Price 6*d.* net.—The method of obtaining the velocity of the wind by the use of observations of pilot balloons with a single theodolite is known to be open to the objection that the assumptions that the rate of ascent of a balloon is constant and that it can be determined by a formula from the weight and buoyancy of the balloon are only roughly true.

At the meteorological station attached to the School of Artillery on Salisbury Plain it is the practice to make observations with two theodolites when possible. In Mr. Batty's analysis 225 ascents have been utilised. The ascents considered were mostly made during the morning

hours from 9 h. to 13 h., and it appears that during these hours the rate of ascent of a balloon is normally much higher than the rate computed by the standard formula. The highest rate, between 12 h. and 13 h. indicates an upward current of no less than 60 ft./min. The effects of cloud and rain and of the character of the wind are also shown to be of considerable importance in determining the rate of ascent. Mr. Batty's paper should go far towards providing empirical rules for modifying the assumed rate of ascent of pilot balloons for single theodolite work in different types of weather.

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

Cirrus Formation at a Low Level; also a Mammato Effect.

YESTERDAY evening, September 14th, 1920, the sky at Barnet was practically overcast and the wind light from a westerly direction, the lower and intermediate clouds drifting slowly from a point north of west.

At 17 h. 40 m. G.M.T. the sun became visible for a short period through a break in the clouds, and my attention was attracted to a very long delicate ribbon of cloud, below the general cloud mass, slightly waved and rendered relatively brilliant by the rays of the declining sun.

As this ribbon approached my zenith its apparent width greatly increased owing to changed perspective and to a probable lateral extension, and it was then that I noticed a striking resemblance to the "wavy gossamer sheets interspersed with feathery wisps of beautiful delicacy" described by Mr. R. Francis Granger in your August number, but there was an absence of tufts with flowing tails described by him.

The phenomenon—or perhaps the appropriate combination of conditions of perspective and ideal illumination—lasted a few minutes only, but during that time possessed to a very marked degree all the outstanding features shown in the illustrations of Ci-Macula (Speckle Cloud) and Ci-Inconstans in Mr. Clayden's "Cloudland."

The clouds above were of a nondescript character, but in the main of a stratiform nature and with some rather clumsy and irregular Cu-Castellatus intermixed. They appeared to be at no very great altitude and, far above, hard white Cirrus fibres were discernible.

The barograph trace, although its general trend was downward, at about this time betrayed a hesitating tendency to rise

but fell decidedly at a later hour owing to the withdrawal to the south-west of a High, and the ensuing weather has been in striking contrast to that recently experienced.

To-day it has been overcast with drizzle and occasional heavy thin rain from low Nimbus, and at 18 h. 30 m. I observed another rather unusual cloud modification, namely, the much-maligned Mammato effect.

This, although admittedly not an everyday occurrence, is not so uncommon as some would have us believe; moreover, it is not confined to the under-surface of more or less horizontal cumuliform cloud canopies, but is frequently an attribute of the "cirrified" extrusion of the "Anvil" cloud, and is also seen occasionally as a modification of low dense Nimbus as in this instance, when well-defined mammillations appeared on two planes together forming an obtuse angle.

The general effect was not unlike that illustrated in Capt. Cave's "The Forms of Clouds," but the protuberances were rather more pronounced and the cloud mass was apparently at a considerably lower altitude.

The phenomenon was unattended here by any demonstration of frightfulness other than the purely spectacular, and, although a rain curtain was noticed in the distance, no precipitation reached earth at this place.

The barometer rose ·04 inch in rather less than an hour, and the wind, which had been feeble, dropped to a complete calm.

A. S. Martin-Smith.

71, Wood Street, Barnet, Herts, 15th September, 1920.

Mammato-Cumulus Clouds over Manchester.

During the last three months five observations of Mammato-Cumulus clouds have been made at this station, one in June, one in July and three in August. Since this type of cloud is perhaps not observed so frequently at other stations, it is thought that a few remarks will be of interest.

On June 14th, 1920, a shallow secondary moved up from England SE. to the Irish Sea. By 18 h. G.M.T. the sky was overcast and gloomy, with A-Cu amount 3, and Cu-Nb amount 6 ($\frac{9}{10}$ of the sky being thus covered with A-Cu and Cu-Nb), travelling at 15–20 mi./hr. from E. at about 2,000 feet height. From 18 h. 15 m. to 18 h. 25 m. Mammato-Cumulus 3, and Cu-Nb 7, were observed.

On July 13th at 18 h. G.M.T. there was a westerly current over this district, due to a low-pressure belt extending from Iceland to Scandinavia and the anticyclone over the Bay of Biscay. The clouds were Cu-Nb 9 and Mammato-Cumulus

at about 3,000 feet which were travelling at 30–40 mi./hr. and had a threatening appearance.

The August observations were on the 3rd, 10th and 14th. On the 3rd at 7 h. G.M.T. the general conditions was similar to those experienced on 13th July, but the westerly current was only about 20 mi./hr. at 2,000 feet. The clouds observed from 9 h. 34 m. to 9 h. 41 m. were A-Cu 1, Mammato-Cumulus 3, and Cu-Nb 6 travelling at the height and speed above mentioned.

On the 10th at 18 h. G.M.T. an anticyclone was spreading in slowly from Ireland, but the locality was still under the influence of the depression over Denmark. The clouds observed were St-Cu 4, Mammato-Cumulus 3 and St. 3 at about 3,000 ft. travelling at 15–20 mi./hr. from WNW.

On the 14th, the pressure distribution at 18 h. G.M.T. was somewhat similar to that on the 10th, the weather of the locality being governed by the north-westerly current between the high pressure over South Ireland, Wales and England SW. and the low pressure over Scandinavia. The clouds were St-Cu 7 and Stratus 3. The Mammato-Cumulus clouds were observed at 20 h. to 20 h. 16 m., and the cloud amount was 3. The sky by then had become cloudy, and as the low St-Cu clouds were passing away to the SE., the structure of these clouds, when observed near the horizon, showed that they were really a degraded type of Cu-Nb.

G. H. L. DOUGLAS-LANE, Capt.

Civil Aerodrome, Alexandra Park, Manchester.

Parallel Bands of Cloud at High Levels.

AN extensive display of parallel bands of cloud at a high level on the evening of September 10th recalled to me a recent article in the *Comptes Rendus* (July 5th, 1920, p. 42) in which M. P. Idrac gives an explanation of such phenomena, opposing that of wave motion. By means of a laboratory experiment he succeeded in showing that if a moving stratum of air of uniform temperature and velocity is adjacent to another of uniform but different temperature and velocity, then a series of vortices is set up, with parallel horizontal axes, and from this he suggests that in the higher strata of the atmosphere, where the condition of horizontal uniformity of temperature and velocity is most easily realised, such may take place, resulting in parallel cloud bands marking the tops of the vortices.

The experiment showed (1) that the bands should be parallel to the relative wind of the two strata (or the vertical gradient of wind velocity); (2) that the sense of rotation of one vortex is opposite to that of the two adjacent vortices.

The explanation that the bands mark the crests of atmospheric waves demands that the bands should be perpendicular to the vertical gradient of wind velocity, and this fact, in conjunction with his first generalization enabled M. Idrac to produce observations in support of his suggestion. It seems to me that the second generalization might also be used, for the edge of the band where the air is rising and cloud forming might well present an appearance differing from that of the other edge, where air is descending and cloud dissipating. Distinguishing between the edges of the bands by "left" and "right" (as one looks along them), M. Idrac's rule demands that the left edge of one band should resemble the right edge of the next, and so on. In my observation of September 10th, all the left edges were alike and also all the right edges, but the left differed markedly from the right. This opposes the vortex suggestion and to some extent supports that of atmospheric waves, which might be expected to produce identical bands. However, M. Idrac has observational support, and his suggestion cannot be ignored. Even if the difference of sharpness of the edges is due solely to the relative wind having a component across the bands as in the wave case, the vortex case should present an observable difference, all edges being identical since the relative wind is along the bands. Perhaps bands of both kinds occur, and observers who have opportunities of watching the skies closely day by day may be able to obtain evidence on this interesting point.

M. A. GIBLETT.

W. Hampstead, 10th September, 1920.

Visibilty on Cloudy Nights.

OBJECTIONS based on Weber's law were raised last month in connection with Captain Pick's method of determining visibility at night. Weber verified his law for illuminations of a white screen varying from 1 to 1,000 centimetre-candles, but the intensities ultimately used in Captain Pick's experiments are very much smaller, and these experiments indicate that Weber's law may not be true for small intensities of illumination.

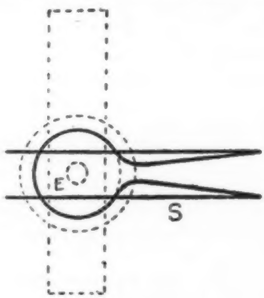
Further, there are two different sets of receptive organs in the retina, known generally as "rods" and "cones," the former coming into play when the light is faint, and having different properties from the "cones," one of which is their inability to distinguish colour. The success of Captain Pick's method might therefore be traceable to the transference from the one set of nerves to the other at faint illuminations.

J. WADSWORTH.

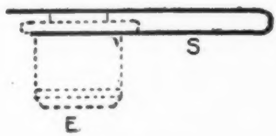
A Simple Form of Light-Filter for Pilot Balloon Work.

A REPORT* has already been published by Mr. Watson Watt on the use of light filters in the observation of pilot balloons, and a form of mounting for the filters was described by him. The following description deals with an extremely simple form of mounting which is very easily constructed, and which has been found to be quite serviceable.

The filters which are used, and which were recommended to the writer by Mr. Watson Watt, are five Wratten Gelatine Filters of the following colours:—1, Dark Red; 2, Stage Red; 3, Orange; 4, Yellow; 5, Blue Green. The Wratten Series "numbers" are F, 27, G, K2, and 44 A respectively. From an old photographic negative two slips of glass were cut, $2\frac{1}{2}$ inches by $\frac{1}{2}$ inch, and on one of them a mask of black paper was built up enclosing a rectangular space $1\frac{7}{8}$ inches by $\frac{5}{16}$ inch. Into this space were laid a $\frac{5}{16}$-inch square of each of the filters in the order given above, with a gap of the same size between Nos. 4 and 5. A mere trace of liquid fish-glue at alternate corners of the filters prevents them from moving, and the other slip of glass is then cemented over them. This completes the filter proper. If desired it can be improved by cementing the whole with soft balsam. A diagram of the device for holding the filter in position against the eye-piece of the theodolite is given below. The middle part of a piece of No. 20 S.W.G. steel



END VIEW.



SIDE VIEW.

piano-wire about 9 inches long is bent into a ring, which is a spring (S) fitting over the barrel of the eye-piece (E). The two ends are led radially outwards side by side for about an inch, at which point they are both bent back upon

* M.O. Circular, No. 44, p. 6.

themselves and return as two parallel prongs about $\frac{5}{16}$ inch apart. The ring is sprung open and slipped over the barrel of the eyepiece so that the two prongs lie across, and press against the milled face of the eye-piece. All that remains to be done is to slip the filter underneath the prongs, so that it is held securely against the face of the eye-piece. In use, it is found to be quite easy to slide the filter parallel to itself, and so change the colour of the filter, without losing sight of the image of the balloon for an instant. By sliding the filter perpendicularly to its length a clear view is obtained, which is better than that obtained by using the blank space in the filter, as was first intended.

The advantage derived from the use of these filters has become evident during the short time that they have been in use here. It has sometimes been found quite easy to retain the balloon by the use of a filter for some time after it has become absolutely invisible without a filter. Moreover, it is found that a change of colour is very restful to the eye, which again conduces to longer ascents.

In particular, a red balloon used with the blue-green filter is very pleasant to work with, especially against a white background of Ci. or A-Cu. The "stage-red" is also extremely effective in cutting out haze.

N. K. JOHNSON.

Shoeburyness, 5th July, 1920.

Line-Squall of July 4th.

THE following information may be of interest in connection with the line-squall of July 4th, mentioned by S. Hyla Greves in the August number of the *Meteorological Magazine.*

The observer on duty on July 4th wrote in the pocket register :—

"Line-squall, 12.30 G.M.T. Rain commenced 12.40. Wind veered to NE. and increased to 22 mi./hr. Sharp rise on micro-barograph. Thunder 12 h. 43 m. Temperature fell 4° F."

I personally remember that the sky presented a very ugly appearance in the early afternoon. The rainfall associated with the squall was slight; indeed the tabulation of the hyetogram shows that the quantity in the hour centred at 13 h. was negligible.

A pilot balloon (rate of ascent 400 ft./min.) released during the passage of the squall was "lost behind the hut" at the end of the first minute, and the computation showed that the wind was from NE. with a speed of 36 m.p.h. It is probable, however, that the balloon had not attained its nominal rate of ascent. At 13 h. the surface wind (40 ft.) was ENE., 16 m.p.h. Bournemouth is situated W. 15° S. of Calshot, and

at a distance of 25 miles. The difference between the times of occurrence of the squall at the two places was approximately 1 h. 10 m.

H. W. L. ABSALOM.

Aerial Navigation School, Calshot, Hants, 23rd August, 1920.

Line Squall of July 24th.

I READ with interest the account of a "Line Squall of July 4th" which occurred in the vicinity of Bournemouth, and should like to give some particulars of a very similar line squall I experienced while at home at Shanklin, Isle of Wight.

On July 24th, at 5h. 30m. G.M.T., I was roused from sleep by the wind, which, after being strong and squally from SW. for the previous 24 hours, had suddenly veered to NNE. and was blowing with great fury, bending trees double and rattling windows. Rain descended in torrents, and it grew so dark that I expected thunder, but none came, only this violent N. gale and torrential rain, and a decided decrease of temperature. This squall continued for about an hour, and then suddenly the sky cleared, the wind backed to NW. and dropped, the rain ceased and a glorious but cool day followed. The amount of rain was 10 millimetres, but at Sandown, $1\frac{1}{2}$ miles NNE. of Shanklin, 20 millimetres were collected. The barograph showed the line squall well, having started to rise immediately the wind shifted. The feature of this sudden squall was the violence of the northerly gale, which swept along, carrying all before it. As far as I could gather, the squall was not noticed in the mainland, though SE. England generally had heavy rain in the early hours of the morning.

J. E. COWPER, Captain.

Mist Formation.

ON September 27th at about 18 h. I saw little wisps of mist forming on the surface of a grass field, not only in the lowest lying ground, but in various parts of the meadow under observation. It gradually spread and flowed down a gentle slope till by 18 h. 15 m. the surface generally was covered to a depth of about 3 feet. About this time I stooped down and noticed that in most parts the mist had risen slightly off the surface and lay like a blanket some 2 feet above the ground. The layer of mist showed a tendency to rise till by 18 h. 30 m. it was 5 feet above the ground in places. At this time the air became misty underneath it again, and a haze began to form which later changed to fog.

The first development of mist was clearly due to cooling of the surface layers by contact with ground which was

radiating heat to a clear sky. Further explanation of the phenomenon is hazardous; I would suggest that the density of the surface layer was reduced owing to the release of latent heat by condensation This layer would be forced up by katabatic currents and radiation being delayed by the blanket of mist, there would be a small interval before the dew-point of the new surface layer could be reached. The humidity at the time was 100 per cent. The haze which changed to fog was probably due to the usual process of mixing.

R. FRANCIS GRANGER.

Lenton Fields, Nottingham, 3rd October, 1920.

A Mock Sun in false Cirrus.

ON two occasions lately a mock sun has been seen at Valencia Observatory in a false cirrus cloud. Presumably this must be a common occurrence, but I do not remember to have seen it before. On the latter occasion the mock sun was very brilliant, and a short portion of the halo of 22° was also to be seen close to it showing well-marked colours.

L. H. G. DINES.

Valencia Observatory, Cahirciveen, 4th Oct. 1920.

Snow at Jerusalem.

MR. GODDEN in a letter to the June number of the *Meteorological Magazine* asks for particulars of the heavy fall of snow which occurred at Jerusalem last February. I happened to be there at the time and so can answer his questions.

The American colony who have been taking meteorological observations there since 1860 reported 29 inches of snow, and 10 inches of rain and melted snow in the six days February 8th to 13th. It was the greatest fall of snow they had ever recorded. It began with heavy rain on February 8th and rain and sleet on February 9th. A blizzard with wind of gale force was blowing on the Mount of Olives on the 9th, but the snow did not lie on the ground until the night of that day. It snowed almost continually all the 10th and 11th, and as far as I can remember some fell on the 12th. It lay thick on the ground until the 15th, and there was still some lying in sheltered spots when I left Jerusalem on the 17th.

The minimum temperature registered on the Mount of Olives during the week was −4° C. Snow fell over a wide area, not only on the hills. It is reported that it lay on the ground at El Arish and some fell at Port Said. The storm was due to a depression which deepened considerably when over the Eastern Mediterranean. Gales and very cold weather were experienced throughout lower Egypt.

H. KNOX-SHAW.

Helwan Observatory, Egypt, 7th July, 1920.

In connection with Mr. Godden's letter in the June Magazine the following may be of interest:

Dr. Shaw was English chaplain at Algiers 1719–34, and during that time travelled extensively, not only in the Barbary States, but also in Egypt, the Sinai Peninsula, Palestine and Syria.

Touching snow at Jerusalem, he writes:—

"It is an observation at or near Jerusalem that provided a moderate quantity of snow falls at the beginning of February, whereby the fountains are made to overflow a little afterwards; there is a prospect of a fruitful and plentiful year; the inhabitants making upon these occasions the like rejoicings with the Egyptians upon the cutting of the Nile."

"The rejoicings that were used upon these occasions seem to have been very great, even to a Proverb: as we may infer from Psalm iv., 7: 'Lord, Thou hast put gladness in my heart, more than at the time when the corn and wine increased.'"

This may be fairly enough paraphrased as follows:—

"There is greater rejoicing over a bountiful snow in February than at a Harvest Festival."

Can any one tell us whether such rejoicings were made after the snow of February 1920?

H. A. Boys,
English Chaplain at Algiers 1875–1889.

North Cadbury Rectory, Somerset, 7th August, 1920.

[Is not the following verse from Proverbs xxv. 13 even more to the point? "As the cold of snow in the time of harvest, so is a faithful messenger to them that send him. For he refresheth the soul of his masters." —Ed. M.M.]

Geostrophic Wind over London; November, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h*., 1881–1908; 7*h*., 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	19	22	23	11	13	88
NE.	2	8	19	4	4	87
E.	12	22	26	11	9	80
SE.	13	20	16	2	—	51
S.	21	39	24	14	9	107
SW.	25	48	58	26	22	179
W.	19	49	86	40	29	223
NW.	18	26	20	25	7	96
Total Frequency of strength	129	234	272	133	93	861*

* Indeterminate—18[illegible]

NOTES AND QUERIES.

The Monthly Flysheet.

WITH the issue on September 1st of a new monthly supplement to the Daily Weather Report the history of the *Monthly Flysheet* was closed. Up to the end of 1916 no information as to the weather of each month as a whole was published officially, until the appearance of the Monthly Weather Report, inevitably about four weeks after the end of the month, though zealous private individuals could, and did, utilise the daily and weekly weather reports in preparing summaries for the newspapers. In other countries, notably in Egypt and in India, summaries based on the telegraphic reports are issued officially within a day or two of the end of the month and the Flysheet was designed to serve the same purpose. The circumstances of the time made it desirable not to incur the expense of printing, and the Flysheet was therefore type-written and duplicated. The tables which supplement the account of the weather were designed to include data which could not be recapitulated in the Monthly Weather Report. For example, the Monthly Weather Report gives the warmest day and coldest night of the month, but the Flysheet gives the coldest day (lowest maximum temperature) and the warmest night (highest minimum temperature). So that data for Dublin might be included in the tables the Superintendent of the Ordnance Survey Office was so good as to arrange for special telegrams to be sent on the first day of each month. Mr. F. J. Brodie was responsible for the preparation of the Flysheet from the first number up to his retirement in March 1920. The new supplement of the Daily Weather Report continues the tables of the Flysheet, whilst tables of upper air conditions and of surface visibility had been introduced.

A Method of Reaching Extreme Altitudes.

MR. R. H. GODDARD, Professor of Physics, Clark College, Worcester, Mass., contributes to *Nature* of August 26th, 1920, an interesting article on "A Method of Reaching Extreme Altitudes," in which he discusses the general principles and possibilities of the method of reaching great altitudes. Professor Goddard proposes to send up rockets which are to be propelled through the air by the ejection of exploded gases at suitable intervals.

He states that "the most important of the immediate applications of the method is in the providing of a simple

and, when sufficiently developed, inexpensive means of obtaining meteorological data at the 10-kilometre level. It is well recognised that this is the most important level for studying pressure, temperature, humidity, and wind velocity; and any means of sending recording instruments rapidly into this region, and of obtaining data soon after the ascent has been made, is certain to be of value in weather forecasting. At greater elevations the study of temperature pressure, wind velocity and composition of the atmosphere is of scientific importance, and also the study of the aurora, during the day as well as at night, and the radiations from the sun that are otherwise absorbed by the atmosphere."

"A further application of much general interest is the possibility of sending a mass beyond the predominating gravitational field of the earth. Concerning the possibility of demonstrating this point by hitting the moon with a rocket, it can be said, apart from the questions of aiming and of correcting the flight, that the ignition of but a few pounds of flash powder should be visible in a powerful telescope, provided, of course, that the conditions of ignition were substantially the same as those in certain experiments described in a recent Smithsonian publication, in which $\frac{1}{20}$ of a grain fired *in vacuo* was observed at a distance of $2\frac{1}{4}$ miles."

Drought and the Climate of Australia.

THE following remarks are summarised from an article which appeared in *The Times* of September 9th:—

The five States of the Australian Continent occupy a fringe of the western, southern and eastern coasts, stretching into an interior that becomes more vaguely known as the tropic is approached. The coast belt contains all the great cities. It is comparatively well watered, has winter rain and is cool in winter almost throughout.

At varying distances from the coast this country gives place to land where rain is always the anxiety of the cultivator. The modern attitude is, however, one of frank acquiescence in drought as a phenomenon of annual occurrence in at least some parts of the continent. Its terrors have also been to some extent removed. All the States keep accurate records of each day's rainfall, and this information is made public daily so that a man threatened with loss of live-stock knows where he can send it if necessary. The multiplication of railways has rendered stock transportation comparatively easy though expensive. The man with capital can thus defy drought, suffering serious temporary

loss, but knowing that if he can hold on, the loss will be more than made good. Inland, Australia is undoubtedly very hot in summer, and this may be the reason for the existing tendency for the country population, even in the most prosperous districts, to drift towards the big cities of the seaboard.

Investigation of the Upper Atmosphere.

At the recent meeting of the British Association at Cardiff the Committee for the Investigation of the Upper Atmosphere was re-appointed with the following members:—Sir Napier Shaw (*Chairman*), Mr. C. J. P. Cave (*Secretary*), Professor S. Chapman, Mr. J. S. Dines, Mr. W. H. Dines, Sir R. T. Glazebrook, Colonel E. Gold, Dr. H. Jeffreys, Sir J. Larmor, Mr. R. G. K. Lempfert, Professor F. A. Lindemann, Dr. W. Makower, Sir J. E. Petavel, Sir A. Schuster, Dr. G. C. Simpson, Mr. F. J. W. Whipple, Professor H. H. Turner.

There has been great development of observations of conditions in the regions accessible to aircraft since the work of the Committee was interrupted by the war, and it will now resume its activities with many new problems calling for investigation.

Obituary.

Meteorologists will regret to hear of the death of *Dr. Max Margules*, of Vienna, on October 4th, 1920. Dr. Margules was born in 1856, and was for many years Secretary of the Zentralanstalt für Meteorologie und Geodynamik at Vienna. His original work dealt mostly with the dynamics of the atmosphere, and particularly with the energy and thermodynamics of storms.

We note with regret the news of the death of *Mr. John Boyd*, Crown Forester, Ford, announced in the *Glasgow Herald* of September 16th. In 1917, when the observations at Poltalloch ceased, Mr. Boyd, at the request of the Office of Woods, converted his rainfall station at Ford into a climatological station with apparatus supplied by the Meteorological Office, since when summaries of his observations have appeared in the weekly and monthy Weather Reports. Mr. Boyd was a well-known forester and published a practical volume on Forestry and numerous other professional papers. Mr. Alexander Cuming is now in charge of the station at Ford.

Review.

A Mechanism of Climatic Cycles.

Batavia, K. Magn. en Meteor. Observatorium. Verh. No. 5. Atmospheric variations of short and long duration in the Malay Archipelago, and the possibility to forecast them. By C. Braak. Batavia, 1919.—One of the main lines of research followed in the attempt to forecast the general character of a season several months of a year in advance has been the investigation of "weather cycles." The cycles which we have been asked at one time or another to accept vary in period indefinitely, but the favourites are the sunspot cycle of 11·2 years and a shorter one of approximately three years. The sunspot cycle, in spite of a sufficient solar basis, has proved disappointing, its meteorological effects being always small and usually debatable. It is well developed only where the response of climatic to solar conditions is of the simplest, as, for example, on the west coast of Africa, where the rainfall, *e.g.*, at Bathurst shows three periodicities of 11 years, amplitude* 192 mm.; 3·2 years, amplitude 180 mm., and 2·1 years, amplitude 102 mm., together with a "secular variation" corresponding to that observable in sunspots since 1870. Even here the amplitude of the short period nearly equals that of the sunspot cycle. On the other hand the three-year period is often very obviously developed, and its only apparent cause—the solar prominence cycle—seems insufficient. To meet this difficulty in the case of Java rainfall, C. Braak has put forward in this memoir a "resonance hypothesis." According to this hypothesis, there may be a a purely terrestrial cycle of cause and effect, which completes itself and returns to its starting point in *about* the same time as the solar prominence cycle. When this happens, the latter fixes the period of the former, and greatly increases the range of its phenomena. The best known effect of "resonance" is the semi-diurnal variation of pressure.

In the case of Java rainfall the chain of events is briefly as follows: Pressure variations at Batavia coincide with those at Port Darwin in Australia, but the latter have double the amplitude of the former. Consequently, remembering that we are dealing with the southern hemisphere, high pressure increases the strength of the East monsoon (November to April) and decreases that of the West monsoon (May to October). It happens that, during the former, high pressure causes low temperature and is self-sustaining, but during the latter high pressure causes high temperature. This in the

* *i.e.*, the coefficient a in the formula $R = \overline{R} + a \sin t$.

course of two years penetrates to the upper air and reduces the pressure below normal. Consequently there is a three-yearly variation of pressure of a "saw-tooth" type, the curve rising slowly for two years and then sinking rapidly for one year. Note that the changes from low to high, or *vice-versa*, can take place only in the West monsoon, and the period is thus limited to exactly three years.

It is obvious that a similar sequence of events must take place at many localities near the equator where conditions are suitable. An example is Lagos, Nigeria, where there is a marked three-year rainfall periodicity. Although pressure data are lacking, we may infer that this is analogous to the case of Batavia, the Sahara taking the place of Northern Australia.

A self-regulating system of a different type has been described by W. Meinardus in the North Atlantic.* Here ice plays a part. A weak Atlantic circulation means ice at Iceland and little off Newfoundland; this raises the pressure to the east of Greenland and lowers it to the west, causing northerly winds over Baffin's Bay and southerly winds at Iceland, so increasing the strength of the Atlantic circulation and reversing the ice conditions. The winter weather in Western Europe is known to be influenced by the strength of the Gulf Drift, and we may suppose the latter to be affected to some extent by the solar prominence period, acting perhaps only at certain seasons of the year. Hence there are indications of a forced periodicity of three years in the weather of Western Europe.

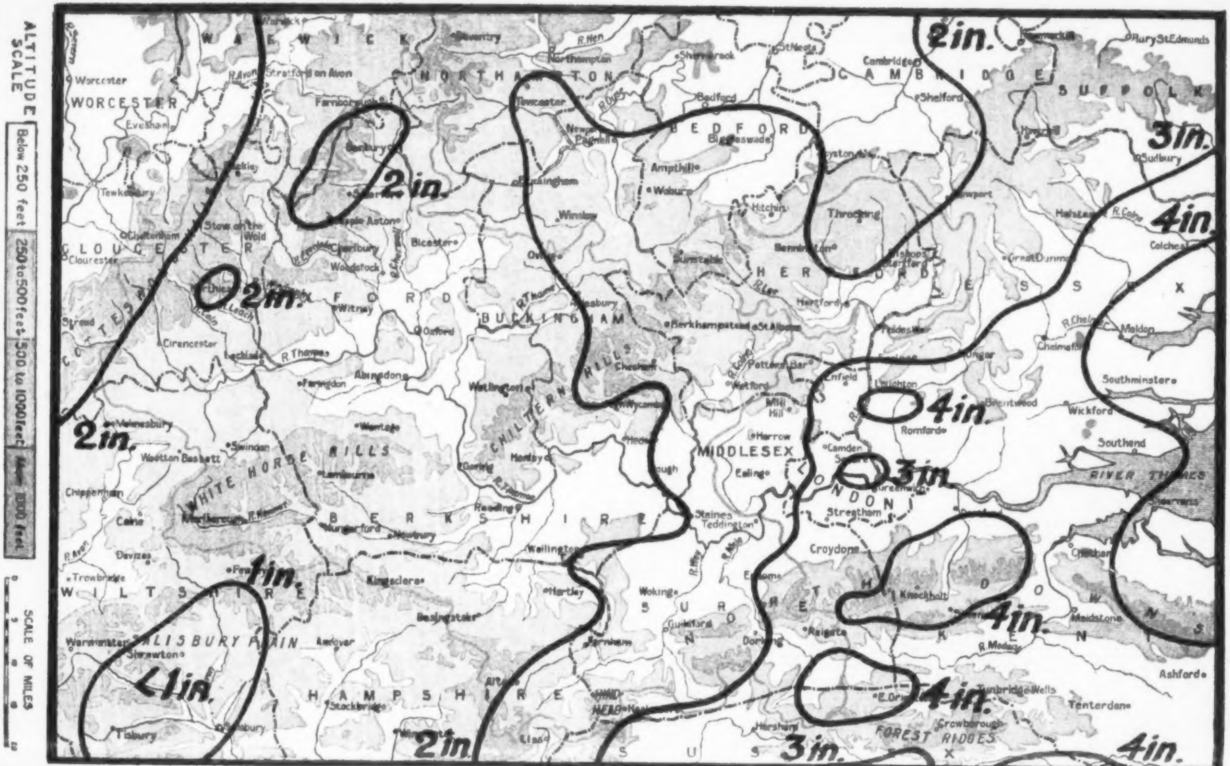
And here, it seems, we have the explanation of why these periodicities so frequently persist for a time, and then break down. For the solar-prominence period is not exactly three years, but a few months longer, so that it will gradually outstrip the terrestrial period. After aiding the latter for a few cycles, it will gradually come to oppose it, the periodicity will die out, or perhaps skip a year or two, and reappear at the wrong dates, when the resonance is re-established. This has hitherto been ascribed to a failure of the cycle, but bearing in mind the new principle, it may be possible in the future to forecast these vagaries. Rainfall forecasts based on the modifications of the three-year period are in fact already being issued in Java, and there seems no reason why they should not be equally practicable in other tropical regions.

C. E. P. BROOKS.

---

* Ann. Hydrogr., Berlin, 1904, p. 353.

THAMES VALLEY RAINFALL SEPTEMBER, 1920.



H M Stationery Office Press, Kingsway W.C.2.

Meteorological Magazine

Isohyetals.

Weather in the British Isles: September 1920.

In many respects the weather of September was more nearly normal than was the case during the three previous months. In the southern districts the temperature not infrequently rose to 70° F., and on some occasions reached 75° F. There were, however, relapses from these pleasant conditions, and on some days in parts of England the temperature remained below 55° F.; while in Scotland on the 20th the maximum at Nairn and Wick was only 47° F. Commonly the maximum occurred on the 12th, when 75° F. was recorded at Bath, Cullompton (Devon), Sevenoaks, South Farnborough, and Weston-super-Mare; and 76° F. at Sparkhill (Worcester) and Kensington Palace. The coldest days occurred during a cold spell which was widely experienced from the 16th to 24th, some of the lowest temperatures recorded being 30° F. at Howden (Yorks), 32° F. at Birr Castle, and 33° F. at Eskdalemuir and Ross-on-Wye on the 20th, and 29° F. at Howden, 31° F. at Nottingham, and 32° F. at Renfrew on the 21st. On the latter date a grass minimum of 24° F. was recorded at Howden and 26° F. at Renfrew. Contrasted with these low readings were the minima at Roche's Point and Scilly on the 26th, 57° F., and at Valencia Observatory on the 27th, 59° F.

On the 14th a large depression over the Icelandic region extended its influence to the whole of the British Isles, and was followed on the 16th by another depression and attendant secondaries, with the result that dull, rainy weather prevailed until the 18th. During this period (14th–18th) there were some heavy falls of rain, 21 mm. falling at Pembroke on the 14th, 20 mm. at Jersey on 15th, 20 mm. at Yarmouth on the 16th. 21 mm. at Falmouth on the 17th, and 26 mm. at Banff, and 25 mm. at Nairn on the 18th. On the latter date there was a gale in the English Channel and thunder at Falmouth. Between the 19th and 23rd, owing largely to shallow depressions over France, there were frequent thunderstorms in Southern and Eastern England, accompanied in some instances by very heavy rain. At Margate on the 21st rain fell from 6 h.-23 h. to a depth of 44 mm., the downpour between 9 h. and 10 h., when there was a thunderstorm, being torrential, with the result that the lower parts of the town were flooded. At Faversham, also during a thunderstorm, and on this same day large hailstones fell. On the 21st Lowestoft experienced a severe thunderstorm and heavy rain which was described as a "cloud-burst," and floods resulted, a visitation which was accompanied by a waterspout at sea. Between the 18th and 21st some very wet weather, with thunderstorms, was also experienced at Guernsey, the total fall for these four days at Brooklyn being 92 mm. and at Villa Carey 90 mm.

Generally speaking, the sunshine of the month was deficient, but there were a good many sunny days, especially from the 9th to the 14th, when more than ten hours a day were recorded in some parts of the country. There was also plentiful sunshine during the week which ended on the 25th, the percentage of the possible duration for this week being as high as at any time during the year.

Over the British Isles as a whole the rainfall was below the average. A considerable area in the South-east of England, and small isolated patches in Ireland and Central Scotland had, however, more than the average. Less than 50 mm. was recorded over large areas in England, from Bournemouth and Torquay across to Boston, and extending along the east coast in a broad band to Aberdeen. In Ireland the south-eastern portion had less than 50 mm. More than 150 mm. was confined to the high land of the Lake District, Wales, Inverness, Connemara and Kerry. The general rainfall expressed as a percentage of the average was:—England and Wales, 95; Scotland, 87; Ireland, 85; British Isles, 89. Apart from the rainfall, there was a good deal of precipitation in the form of dew; wet fogs and mists were especially prevalent during two anticyclonic periods which

(*Continued on* p. 212.)

Rainfall Table for September 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·00	3·27	83	163	·74	15	14
Tenterden (View Tower)	*Kent*	2·25	3·32	84	148	·78	15	17
Arundel (Patching)	*Sussex*	2·58	4·25	108	165	1·23	15	11
Fordingbridge (Oaklands)	*Hampshire*	2·39	1·35	34	56	·32	17*	14
Oxford (Magdalen College)	*Oxfordshire*	1·98	1·55	39	78	·27	30	13
Wellingborough	*Northampton*	2·13	..	..	..	..	..	..
Hawkedon Rectory	*Suffolk*	1·95	2·32	59	119	·48	15	14
Norwich (Eaton)	*Norfolk*	2·34	2·21	56	94	·55	16	19
Launceston (Polapit Tamar)	*Devon*	3·11	2·03	52	65	·90	30	15
Lyme Regis (Rousdon)	"	2·69	1·46	37	54	·54	30	9
Ross (Birchlea)	*Herefordshire*	2·39	1·75	44	73	·45	17	12
Church Stretton (Wolstaston)	*Shropshire*	2·40	2·02	51	84	·54	14	11
Boston (Black Sluice)	*Lincoln*	2·07	1·57	40	76	·29	17	15
Worksop (Hodsock Priory)	*Nottingham*	1·84	1·59	40	86	·44	14	15
Mickleover Manor	*Derbyshire*	2·11	1·95	50	92	·78	17	13
Southport (Hesketh Park)	*Lancashire*	3·09	3·14	80	102	·62	30	15
Wetherby (Ribston Hall)	*York, W. R.*	2·11	1·15	29	55	·24	14	..
Hull (Pearson Park)	" *E. R.*	2·05	1·60	41	78	·38	14	11
Newcastle (Town Moor)	*North'land*	2·00	1·72	44	86	·38	16	17
Borrowdale (Seathwaite)	*Cumberland*	11·28	10·50	267	93	..	..	..
Cardiff (Ely)	*Glamorgan*	3·61	3·05	78	84	1·30	17	14
Haverfordwest	*Pembroke*	3·91	3·74	95	96	1·24	14	18
B'ham W. W. (Tyrmynydd)	*Radnor*	4·43	4·34	110	98	1·03	14	13
Llandudno	*Carnarvon*	2·50	4·10	104	164	·81	18	16
Dumfries (Cargen)	*Kirkcudbrt.*	3·34	2·62	66	78	·55	17	16
Marchmont House	*Berwick*	2·67	1·81	46	68	·31	9	16
Girvan (Pinmore)	*Ayr*	4·30	3·00	76	70	·65	9	21
Glasgow (Queen's Park)	*Renfrew*	2·99	2·43	62	81	·60	9	19
Islay (Eallabus)	*Argyll*	4·49	4·74	120	106	·59	16	27
Mull (Quinish)	"	5·20	6·04	153	116	·72	9	25
Loch Dhu	*Perth*	6·22	4·50	114	72	·80	11	13
Dundee (Eastern Necropolis)	*Forfar*	2·34	2·79	71	119	·52	16	19
Braemar	*Aberdeen*	2·73	1·45	37	53	·30	17	16
Aberdeen (Cranford)	"	2·69	2·24	57	83	·81	18	15
Gordon Castle	*Moray*	2·58	3·10	79	120	1·76	18	14
Drumnadrochit	*Inverness*	2·94	1·40	36	48	·45	10	14
Fort William	"	6·66	4·76	121	71	1·01	27	26
Loch Torridon (Bendamph)	*Ross*	7·28	6·44	164	88	·97	27	21
Stornoway	"	3·99	4·26	108	107	·43	20	24
Dunrobin Castle	*Sutherland*	2·51	3·01	76	112	·31	17	18
Wick	*Caithness*	2·57	2·44	62	95	·74	9	13
Glanmire (Lota Lodge)	*Cork*	3·20	2·98	76	93	·76	29	13
Killarney (District Asylum)	*Kerry*	3·79	4·32	110	114	1·25	29	23
Waterford (Brook Lodge)	*Waterford*	3·19	1·79	46	56	·49	14	13
Nenagh (Castle Lough)	*Tipperary*	3·16	2·06	52	65	·28	16	21
Ennistymon House	*Clare*	4·22	4·51	115	107	·82	29	21
Gorey (Courtown House)	*Wexford*	2·78	1·06	27	38	·44	30	10
Abbey Leix (Blandsfort)	*Queen's Co.*	2·93	1·06	27	36	·22	9	15
Dublin (FitzWilliam Square)	*Dublin*	2·06	1·02	26	50	·23	9	14
Mullingar (Belvedere)	*Westmeath*	3·02	1·96	50	65	·30	14	13
Woodlawn	*Galway*	3·47	2·77	70	80	·51	16	21
Crossmolina (Enniscoe)	*Mayo*	4·42	5·92	150	134	·73	26	26
Collooney (Markree Obsy.)	*Sligo*	3·65	3·15	80	86	·74	1	25
Seaforde	*Down*	3·25	2·81	71	86	·72	30	13
Ballymena (Harryville)	*Antrim*	3·43	4·11	104	112	·73	1	19
Omagh (Edenfel)	*Tyrone*	3·39	2·72	69	80	·40	1	21

* And 30.

Supplementary Rainfall, September 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	3·38	86	XII.	Langholm, Drove Rd.	2·55	65
,,	Sevenoaks, Speldhurst	3·96	101	XIII.	Selkirk, Hangingshaw	1·79	46
,,	Hailsham Vicarage...	3·26	83	,,	North Berwick Res ...	1·20	30
,,	Totland Bay, Aston ..	2·26	57	,,	Edinburgh, Royal Ob.	1·47	37
,,	Ashley, Old Manor Ho.	1·31	33	XIV.	Biggar..............	2·33	59
,,	Grayshott...........	2·81	71	,,	Leadhills	5·58	142
,,	Ufton Nervet........	1·25	32	,,	Maybole, Knockdon ...	2·53	64
III.	Harrow Weald, Hill Ho.	2·37	60	XV.	Rothesay	4·08	104
,,	Pitsford, Sedgebrook..	1·46	37	,,	Ardgour House	6·48	165
,,	Chatteris, The Priory.	2·03	52	,,	Inveraray Castle	5·79	147
IV.	Elsenham, Gaunts End	2·37	60	,,	Holy Loch, Ardnadam	5·70	145
,,	Lexden, Hill House ..	3·74	95	XVI.	Loch Venachar	3·50	89
,,	Aylsham, Rippon Hall	2·66	68	,,	Glenquey Reservoir ...	4·00	102
,,	Swaffham...........	2·10	53	,,	Loch Rannoch, Dall...	1·89	48
V.	Devizes, Highclere ...	1·34	34	,,	Coupar Angus........	1·48	38
,,	Weymouth	1·59	40	,,	Montrose Asylum	1·25	32
,,	Ashburton, Druid Ho.	2·18	55	XVII.	Balmoral Castle.......	2·29	58
,,	Cullompton	1·84	47	,,	Fyvie Castle..........	2·99	76
,,	Hartland Abbey	3·42	87	,,	Peterhead, Forehill....	2·67	68
,,	St. Austell, Trevarna .	3·82	97	,,	Grantown-on-Spey ...	2·56	65
,,	North Cadbury Rec. .	1·55	39	XVIII.	Cluny Castle	2·69	68
,,	Cutcombe, Wheddon Cr.	1·95	50	,,	Loch Quoich, Loan ...	11·26	286
VI.	Clifton, Stoke Bishop.	2·51	64	,,	Skye, Dunvegan	6·96	177
,,	Ledbury, Underdown.	1·96	50	,,	Fortrose	2·03	52
,,	Shifnal, Hatton Grange	1·88	48	,,	Ardross Castle	2·68	68
,,	Ashbourne, Mayfield .	1·92	49	,,	Glencarron Lodge	4·96	126
,,	Barnt Green, Upwood	2·70	69	XIX.	Tongue Manse	3·85	98
,,	Blockley, Upton Wold	2·72	69	,,	Melvich Schoolhouse ..	3·24	82
VII.	Grantham, Saltersford	1·38	35	,,	Loch More, Achfary...	6·70	170
,,	Louth, Westgate	1·44	37	XX.	Dunmanway Rectory..	4·08	104
,,	Mansfield, West Bank	1·49	38	,,	Mitchelstown Castle...	2·53	64
VIII.	Nantwich, Dorfold Hall	2·87	73	,,	Gearahameen	7·00	178
,,	Bolton, Queen's Park.	3·45	88	,,	Darrynane Abbey	5·42	138
,,	Lancaster, Strathspey.	2·91	74	,,	Clonmel, Bruce Villa ..	1·69	43
IX.	Wath-upon-Dearne...	1·16	30	,,	Cashel, Ballinamona...	1·81	46
,,	Bradford, Lister Park.	1·46	37	,,	Roscrea, Timoney Pk..	1·46	37
,,	West Witton.........	1·31	33	,,	Foynes..............	3·13	80
,,	Scarborough, Scalby..	1·68	43	,,	Broadford, Hurdlesto'n	3·21	82
,,	Ingleby Greenhow ...	1·61	41	XXI.	Kilkenny Castle.......	1·18	30
,,	Mickleton...........	1·20	30	,,	Rathnew, Clonmannon	1·06	27
X.	Bellingham	1·40	36	,,	Hacketstown Rectory .	1·54	39
,,	Ilderton, Lilburn ...	2·02	51	,,	Ballycumber, Moorock	1·30	33
,,	Otton..............	2·94	75	,,	Balbriggan, Ardgillan .	1·40	36
XI.	Llanfrechfa Grange ..	3·23	82	,,	Drogheda	1·56	40
,,	Treherbert, Tyn-y-waun	7·71	196	,,	Athlone, Twyford	1·77	45
,,	Carmarthen Friary...	5·92	150	,,	Castle Forbes Gdns....	2·47	63
,,	Fishguard..........	4·37	111	XXII.	Ballynahinch Castle...	7·69	195
,,	Lampeter, Falcondale	5·21	132	,,	Westport House	3·93	100
,,	Abergwngy..........	6·75	171	XXIII.	Enniskillen, Portora...	2·98	76
,,	Cray Station.........	6·70	170	,,	Armagh Observatory ..	2·27	58
,,	Crickhowell, Talymaes	4·50	114	,,	Warrenpoint	2·56	65
,,	Lake Vyrnwy.......	2·18	55	,,	Banbridge, Miltown...	2·49	63
,,	Llangynhafal, P. Drâw	3·11	79	,,	Belfast, Cave Hill Rd..	2·82	72
,,	Dolgelly, Bryntirion..	7·55	192	,,	Glenarm Castle	3·40	86
,,	Lligwy	2·77	70	,,	Londonderry, Creggan.	3·50	89
XII.	Stoneykirk, Ardwell Ho.	3·43	87	,,	Sion Mills............	2·85	72
,,	Whithorn, Cutroach..	3·52	89	,,	Milford, The Manse ...	3·99	101
,,	Carsphairn, Shiel.....	4·14	105	,,	Killybegs, Rockmount.	6·50	165

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and ½ min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1006·8	−7·1	63	24	35	30	55·2	43·3	49·3	+2·0
Gibraltar	1017·4	+2·1	74	26	48	1	68·7	54·4	61·5	+0·7
Malta	..	..	..	..	..	..	..	..	..	..
Sierra Leone	1012·2	+1·2	91	5,22,25	71	9, 10	88·8	73·9	81·3	−1·5
Lagos, Nigeria	1012·6	+2·8	89	5	71	12	87·6	75·8	81·7	−0·6
Kaduna, Nigeria	1013·9	+5·6	98	3, 8, 14	66	20	93·3	70·8	82·1	−0·4
Zomba, Nyasaland	1016·4	+4·5	81	9, 10	55	20, 29	74·7	58·8	66·7	−2·6
Cape Town	..	..	96	14	48	25	77·3	56·6	66·9	+3·8
Johannesburg	..	..	77	20	44	29	72·0	50·3	61·1	+1·5
Mauritius	1013·2	−0·8	84	12	58	17	80·2	69·4	74·8	−1·0
Bloemfontein	..	..	79	5	40	27	75·1	47·3	61·2	+0·4
Calcutta, Alipore Obsy.	1006·9	+0·6	103	29	69	12	94·6	76·7	85·7	0·0
Bombay	1008·7	+0·1	92	22	73	5	89·5	77·7	83·6	+0·5
Madras	..	..	98	24	74	15	93·0	77·7	85·3	0·0
Colombo, Ceylon	1009·3	+0·2	91	17	73	14	87·7	74·9	81·3	−1·4
Hong Kong	1012·9	+0·3	82	19	60	7	73·3	66·5	69·9	−1·0
Sydney	1020·3	+2·0	81	23	48	18	70·7	56·0	63·3	−1·1
Melbourne	..	..	..	..	..	..	..	..	..	..
Adelaide	1022·4	+2·6	95	1	46	19	72·8	53·1	62·9	−0·9
Perth, West Australia	1019·6	+1·2	81	7	51	30	79·2	57·7	68·5	+2·2
Coolgardie	1020·9	+2·4	85	28	44	30	73·3	50·0	61·7	−3·4
Brisbane	1018·7	+1·4	87	12	52	26	78·2	61·0	69·6	−0·8
Hobart, Tasmania	1018·1	+3·7	82	2	39	25	62·8	47·2	55·0	−0·1
Wellington, N.Z.	1018·6	+0·8	70	8	38	15	61·6	52·6	57·1	+0·3
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	1013·8	−0·5	90	26	67	8	87·5	71·7	79·6	+1·2
Grenada, W.I.	1014·1	+1·5	87	6	70	2	83·4	73·5	78·5	−0·3
Toronto	1009·3	−6·2	60	19	18	8	47·6	32·6	40·1	−1·3
Fredericton, N.B.	..	..	67	20	15	2	47·5	28·7	38·1	−0·4
St. John, N.B.	1007·8	−5·8	62	20	21	1	45·1	30·6	37·9	−1·1
Victoria, B.C.	1016·4	−0·9	65	25	30	2	51·9	39·0	45·5	−2·2

LONDON, KEW OBSERVATORY.—1 day of thunder. Mean speed of wind 8·6 mi/hr.

GIBRALTAR.—2 gales.

SIERRA LEONE.—1 day with thunder heard ; 1 gale.

MAURITIUS.—Prevailing wind direction ESE. ; mean speed, 9·3 mi/hr.

BOMBAY.—1 day of thunder.

COLOMBO, CEYLON.—Prevailing wind direction SW. ; mean speed, 3·4 mi/hr. ; 3·6 ins. rainfall in 131 mins. on 26th, April 30–May 1, first night of continuous SW. wind through night this year. 12 days with thunder.

British Empire, April 1920.

TEMPERATURE: Absolute, Max. in Sun °F.	TEMPERATURE: Absolute, Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION: Amount in.	PRECIPITATION: Amount mm.	PRECIPITATION: Diff. from Normal mm.	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible	STATIONS
126	27	79	8·1	2·67	68	+ 31	20	2·6	19	London, Kew Observatory.
153	44	77	3·9	0·99	25	− 43	6	..	..	Gibraltar.
..	..	..	..	..	..	..	..	..	..	Malta.
..	..	67	3·5	0·31	8	− 97	3	..	..	Sierra Leone.
165	64	73	6·5	5·71	145	− 4	14	..	..	Lagos, Nigeria.
..	..	70	..	5·90	150	+ 82	7	..	..	Kaduna, Nigeria.
..	..	89	5·9	1·63	41	− 64	10	..	..	Zomba, Nyasaland.
..	..	67	3·5	0·76	19	− 32	4	..	..	Cape Town.
..	36	67	2·6	0·84	21	− 31	8	8·6	75	Johannesburg.
..	52	77	7·1	4·60	117	+ 3	15	5·6	49	Mauritius.
..	..	62	1·5	0·21	5	− 49	4	..	..	Bloemfontein.
..	61	57	3·2	0·04	1	− 43	1	..	..	Calcutta, Alipore Obsy.
..	..	77	2·5	0·00	0	− 2	0	..	..	Bombay.
168	72	74	3·8	0·06	2	− 13	1	..	..	Madras.
159	69	78	8·4	14·77	375	+123	22	..	..	Colombo, Ceylon.
..	..	82	9·0	8·27	210	+ 70	16	2·6	21	Hong Kong.
128	42	71	5·6	2·82	72	− 67	17	..	..	Sydney.
..	..	..	..	..	..	..	..	..	..	Melbourne.
144	33	54	4·7	0·57	14	− 33	8	..	..	Adelaide.
151	40	50	2·1	0·00	0	− 41	0	..	..	Perth, West Australia.
143	35	49	3·9	0·70	18	− 6	7	..	..	Coolgardie.
144	44	65	4·7	1·99	51	− 42	13	..	..	Brisbane.
131	34	67	6·1	1·04	26	− 22	12	..	..	Hobart, Tasmania.
141	33	78	7·7	8·77	223	+124	15	3·7	34	Wellington, N.Z.
..	..	..	..	..	..	..	..	..	..	Suva, Fiji.
..	..	69	1·8	0·00	0	− 31	0	..	..	Kingston, Jamaica.
138	..	68	3·5	0·30	8	− 52	7	..	..	Grenada, W.I.
110	15	75	5·7	3·26	83	+ 22	14	..	..	Toronto.
..	..	..	..	5·73	146	+ 71	11	..	..	Fredericton, N.B.
123	18	79	6·6	5·01	127	+ 38	16	..	..	St. John, N.B.
128	26	75	5·2	1·45	37	− 7	13	..	..	Victoria, B.C.

HONG KONG.—Prevailing wind direction E; mean speed, 14·0 mi/hr.; 4 days with thunder heard; 8 fogs,

GRENADA.—Prevailing wind direction E.

PERTH.—Only recorded instance of a totally rainless April in Perth.

BRISBANE.—Rainfall below average 24 months out of last 27 months.

KINGSTON ISLAND.—Drought —0·29 in. for the Island—lowest fall ever recorded.

extended from the 8th to 14th and from the 19th to 29th. At Totland Bay (Isle of Wight) the mean humidity at 9 h. was 87 per cent., this being the dampest September since 1897.

In London (Camden Square) the month was generally cloudy with frequent rain. The mean temperature was 57·9° F., or 0·2° F. above the average. The duration of rainfall was 48·2 hours, and the evaporation 1·04 inch.

Weather Abroad: September 1920.

At the beginning of the month anticyclonic areas were situated over Scandinavia and the Azores, and low-pressure areas over Central Europe and Iceland. On the 3rd, the northern anticyclone moved northwards to Spitzbergen, and a depression moving in from Iceland was by the 5th centred over Southern Scandinavia, causing very unsettled weather in its passage, with gales over Denmark and the Southern Baltic.

Meanwhile the Azores anticyclone began to spread slowly in a north-easterly direction. By the 8th this anticyclone covered southern England, Northern France and Germany, and by the 11th it was centred over Western Germany, whence it moved slowly south-east.

Pressure still continued high at the Azores and Spitzbergen, and depressions, moving in an easterly direction from Iceland, caused heavy rain in places. At Oxo (Southern Norway) 72 mm. of rain fell on the 15th. On the 16th a depression appeared to the westward of the British Isles, crossed them on the 18th, and reached Southern Scandinavia on the 19th, whence it moved northwards and by the 22nd was over Spitzbergen. Some heavy falls of rain occurred during this period, especially in France and Switzerland (51 mm. at Lugano on the 17th, 47 mm. at Lyons on the 18th, 59 mm. at Lugano on the 19th, and 70 mm. at Lugano on the 20th).

By the 22nd an anticyclone extended from the Azores to the Baltic, and high pressure was maintained over Western and Central Europe until the end of the month, although small, shallow depressions over France caused local heavy rain. On the last day of the month a deep depression approached the SW. of the British Isles, and affected France, causing heavy falls of rain (*e.g.*, 48 mm. at Clermont). Temperatures throughout the month were not high except locally in Southern Europe (*e.g.*, 90° F. at Madrid on the 7th and at Rochefort on the 11th, and 91° F. at Marseilles on the 30th).

In Italy and the Eastern Mediterranean the weather throughout the month was warm and for the most part fine, except for some local rain in Italy, more especially in the northern districts.

A severe wind and hail storm in the middle of the month destroyed orchards and vineyards in the Niagara fruit district, and on the 20th lightning struck seven oil storage tanks at the Anglo-American oil refinery at Tampico, setting them on fire and causing considerable damage.

At the end of September there were many prairie fires in Saskatchewan and Manitoba. Sufficient rain fell at the beginning of October to extinguish them, but not before considerable loss had been caused to farmers.

A message from Buenos Aires, dated September 22nd, stated that moderate to heavy rains were falling generally over the Argentine. This rainfall constitutes a definite break in the drought which has been damaging the various crops for a considerable period.

The rainfall in India has been variable, many districts receiving an excess and others a deficiency. The Punjab is badly in need of rain, but the position has improved in the Bombay Presidency, as well as in the Western Deccan, in the United Provinces, in Hyderabad and in Madras.

The long-continued drought in the Honan Province of China has led to severe famine, so that thousands of lives are in danger, and it is estimated that it will take years for the district to recover. A certain amount of rain fell, however, in the province during September.